



---

# OTF CCSDS Mission Operations Prototype Parameter Service

## Phase I Exit Presentation

John Stevens

02/25/2009



# Project Goals

---

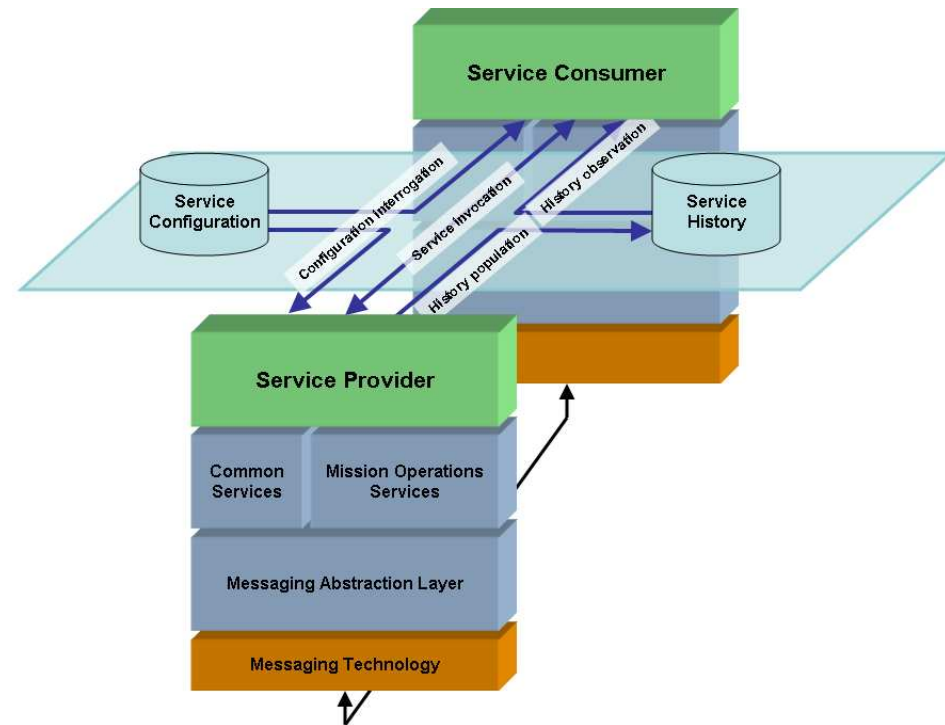
- Demonstrate the use of Mission Operations standards to implement the Parameter Service
- Demonstrate interoperability between Houston MCC and a CCSDS Mission Operations compliant mission operations center
- Utilize Mission Operations Common Architecture



# Project Goals

## Utilize Common Architecture

- Service Provider (Center A)
- Service Consumer (Center B)
- SM&C Standards (blue boxes)
  - MAL provides
    - Standard Patterns of Interaction
    - Fundamental definitions
  - Common Services provides
    - Standard Model for Services to Extend
    - Infrastructure Services
  - Mission Operations
    - Core Monitoring and Control, Planning, ...
- Messaging Technology (e.g. AMS, SOAP, ...)



Common Architecture Service Stack View



# Project Benefits

---

- Demonstration
  - Prototype CCSDS Blue Book service specifications
  - Pathfinder for inter-center communications
- Use of CCSDS Standards
  - International agreement
  - Reduce Cost
- Investigation of new technologies
  - Service Oriented Architecture (SOA) concepts



# Project Definition

---

- Demonstrate Mission Operations Protocols
  - Scope
    - Implement the Core Services Parameter Service
    - Implement the Common Services Common Model Service monitorStatus Operation
    - Implement the Message Abstraction Layer (MAL)
    - Implement Information Sharing Protocol (ISP) for the transport layer
    - Interface with a Common Services Directory Service



# Project Definition

---

- Out of scope (Related Services)
  - Core Services Check Service
  - Common Services Common Model Service Operations
    - request, list Status
    - request, list, monitor, add, modify, delete, and delete all Definitions
  - Core Service Parameter Service
    - set/get Filtered
    - set/get Timeouts
  - Common Services Configuration Management Service
- Dependencies
  - OTF MO Common Services Directory Services Interface



# Parameter Service Design

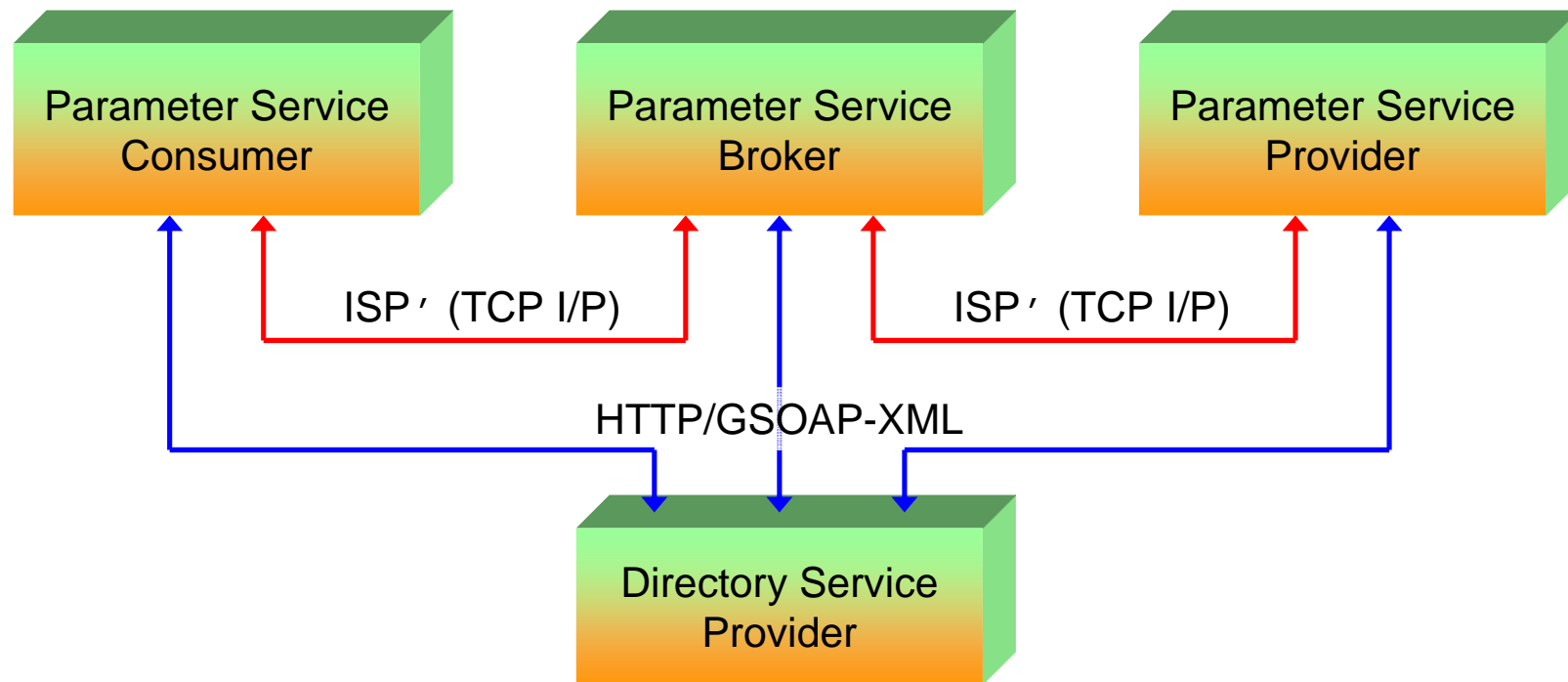
---

- Parameter Service Provider and Consumer Integrated Products
  - ANSI C
  - Based on the MCC Information Sharing Protocol (ISP) Client Toolkit
  - ANSI C GSOAP-XML Directory Service API
- Parameter Service Broker Integrated Products
  - ANSI C
  - Based on the MCC Information Sharing Protocol (ISP) Server Toolkit
  - ANSI C GSOAP-XML Directory Service API



# Parameter Service - Interfaces

---



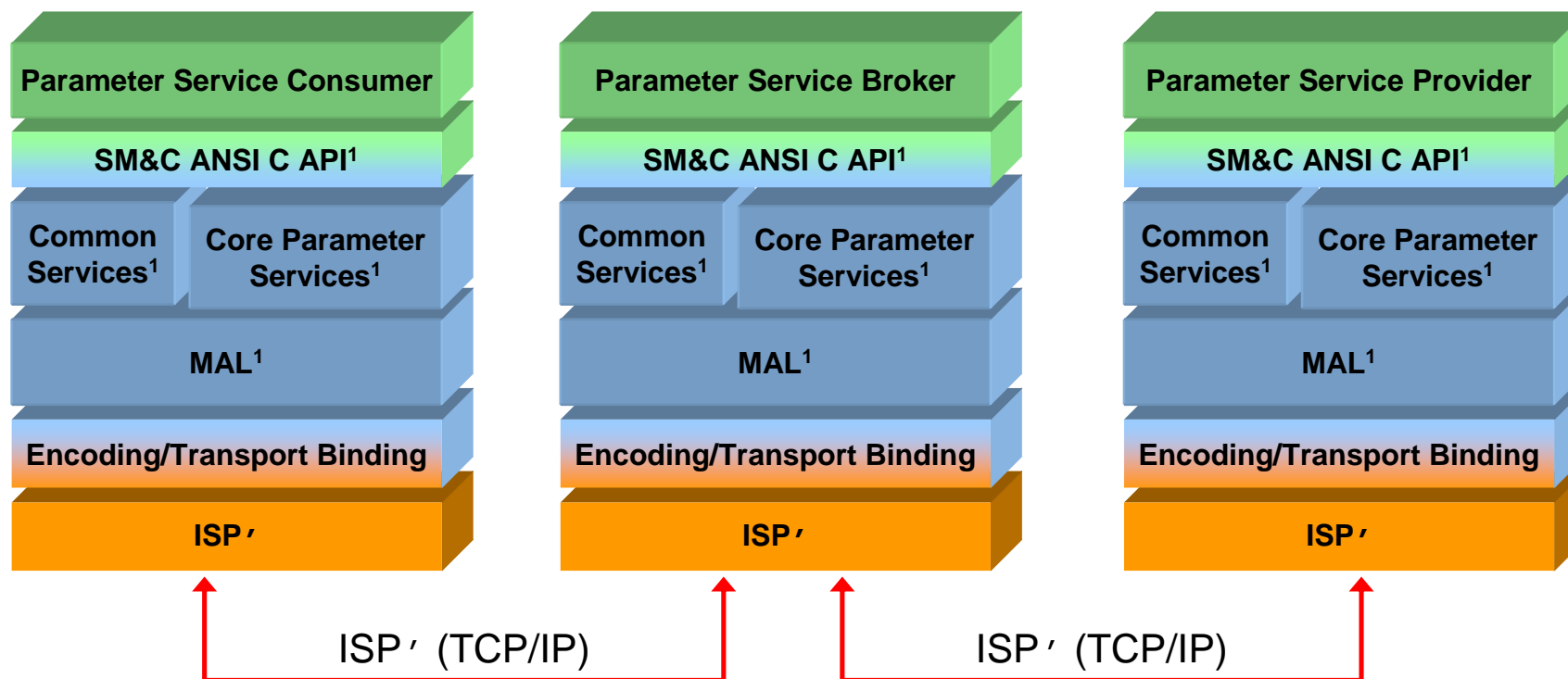
ISP' is a revised version of the ISP protocol for SM&C compliant messages.

---





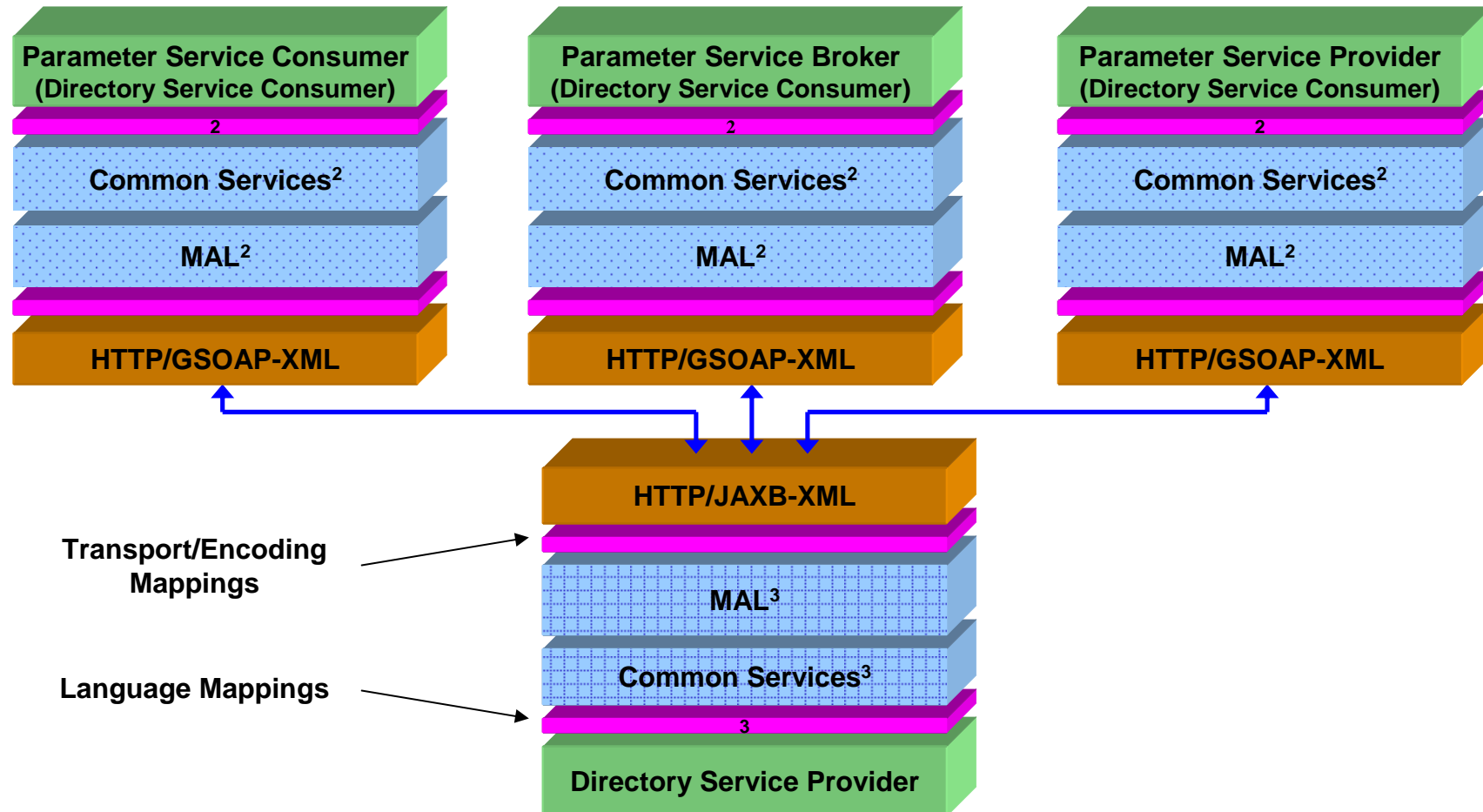
# Parameter Service - Interfaces



<sup>1</sup> SM&C ANSI C Implementation (MAL, Common Services, and Core Services).



# Parameter Service - Interfaces

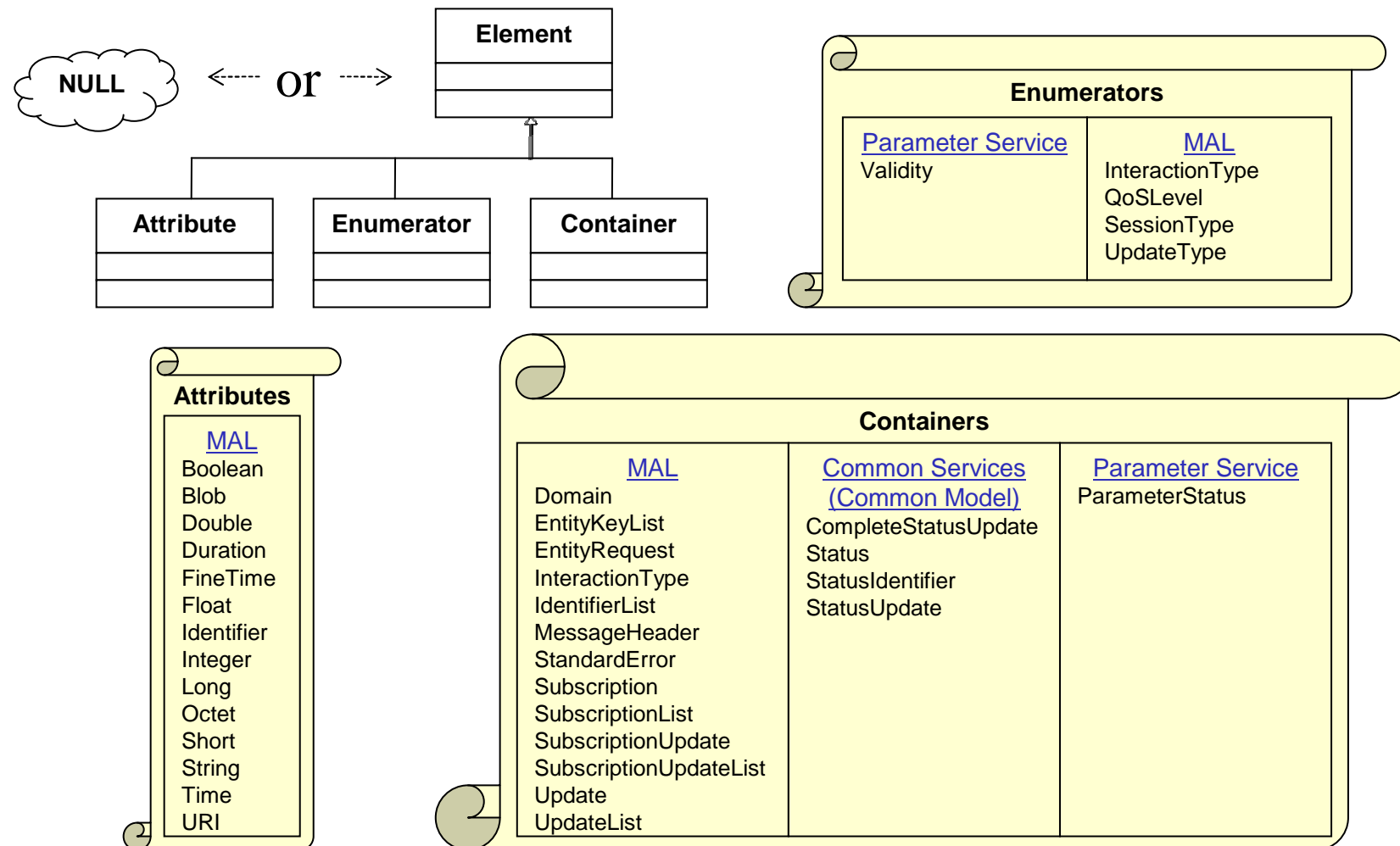


<sup>2</sup> SM&C ANSI C GSOAP-XML Implementation (MAL, Common Services).

<sup>3</sup> SM&C Java JAXB-XML Implementation (MAL, Common Services).



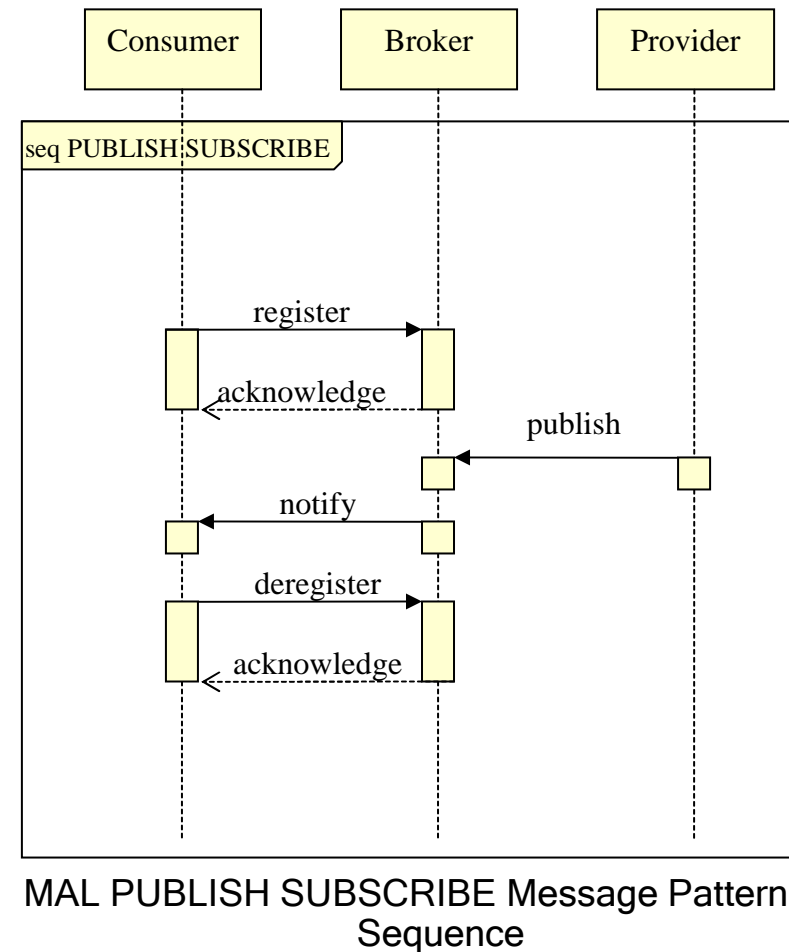
# Parameter Service - Structures





# ANSI C Parameter Service

- ANSI C API Layer
  - Monitor Status operations support the Consumer-Broker-Provider interaction
    - SmcInitialize
    - CP\_registerMonitorStatus
    - CP\_deregisterMonitorStatus
    - CP\_publishMonitorStatus
    - CP\_notifyMonitorStatus
- MAL, Common Services, and Parameter Service Layers
  - Constructors, Destructors, Accessors
- Transport/Encoding Mappings
  - MCC ISP transport modified to support MAL PUBLISH SUBSCRIBE Pattern of Interaction
  - Binary Encoding of MO Structures





# Results

---

- Four (4) RIDS against MAL Book
- Two (2) RIDS against Common Services Book
- Two (2) RIDS against Core Services Book
- Three (3) generalized RIDS across the MAL, Common Services, and Core Services Books



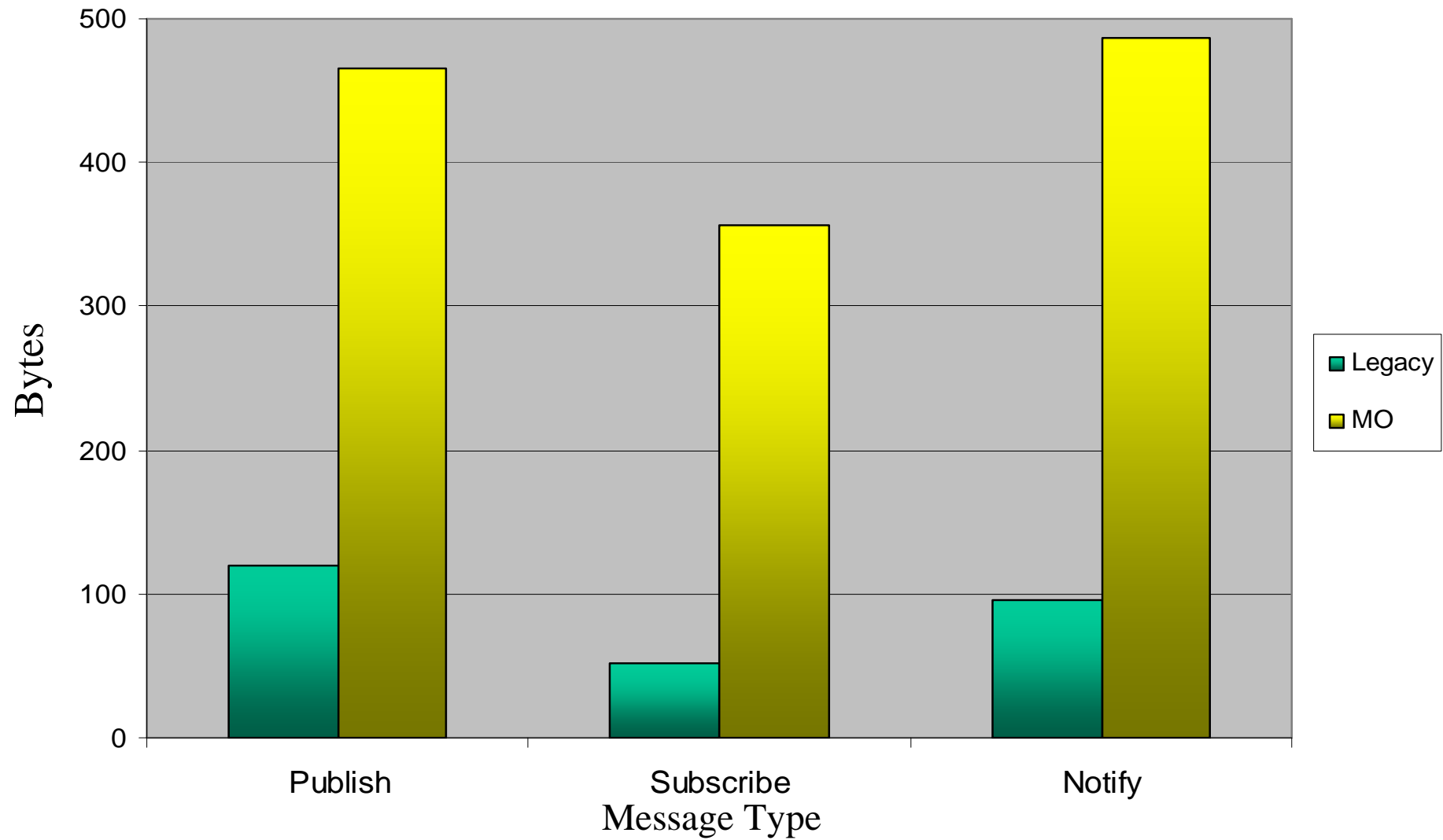
# Lessons Learned

---

- Significant amount of effort to modify legacy applications for SOA
- Message sizes significantly larger for Mission Operations than for legacy telemetry distribution



# Message Size





# Conclusions

---

- Findings
  - To verify the CCSDS MO Standards meets manned spaceflight telemetry requirements, at a minimum the Parameter Service must be evaluated with the Check Service
  - Large amount of effort to modify legacy applications for SOA
  - Message sizes are significantly larger for Mission Operations





# Contacts

---

- Management
  - Lindolfo Martinez (281) 483-4346 / 2099
  - [lindolfo.martinez-1@nasa.gov](mailto:lindolfo.martinez-1@nasa.gov)
- Technical Lead (MO Prototype)
  - Walter Reynolds (281) 483-6723 / 2099
  - [walter.f.reynolds@nasa.gov](mailto:walter.f.reynolds@nasa.gov)
- Responsible Engineer (Parameter Service)
  - John Stevens (281) 853-2343 / 595 Gemini
  - [john.e.stevens@nasa.gov](mailto:john.e.stevens@nasa.gov)
- Project Sponsors
  - Eric Wolfer (281) 483-6709 / 2014A
  - [eric.j.wolfer@nasa.gov](mailto:eric.j.wolfer@nasa.gov)



# Thank You

---

- Questions

CCSDS Mission Operations  
Parameter Service Demonstration

Screen Shots

## 1. Parameter Service Provider Log File

```
SM&C Log (parm_publisher.smclog)

>>>PUBLISH Message Header:
{msgHeader = {dataType = x; endianism = 0}, URIfrom = "lance", authenticationId
= {(9 bytes @ addr 5d8af0):
    00000: 616E 6F6E 796D 6F75 73 [anonymous]
}, URIto = "THERE", timestamp = 054/13:53:23.103, QoSlevel = 2, priority = 1, do
main = {"otf", "parmsvc", "sim"}, networkZone = "", session = 2, sessionName = "
ISP-InControl SIM", interactionType = 6, interactionStage = 3, transactionId = "
parm_publisher(4)", area = "1", service = "1", operation = "8", version = 1, isE
rror = 0}
>>>PUBLISH Message Body: updateList =
timestamp = 054/13:53:23.103; sourceURI = lance; updateType = 2;
idList = {"SIN0000"}
entityId = (null); definitionId = (null); occurrenceId = (null); statusId = (nul
l); timestamp = 054/13:53:23.103;
generationMode = 1; validityState = 2; rawValue = 39.073113; convertedValue = 39
.073113
>>>Encoded PUBLISH (cMLCompleteStatusUpdate) Message:
(446 bytes @ addr bfffd040):
    00000: 7800 0000 0001 5500 0000 0001 0600 6C61 [x.....U.....la]
    00010: 6E63 6500 4C00 0000 0001 0900 616E 6F6E [nce.L.....anon]
    00020: 796D 6F75 7355 0000 0000 0106 0054 4845 [ymousU.....THE]
    00030: 5245 0054 0000 0000 011F 85DD 1A8F 7794 [RE.T.....w.]
    00040: 404F 0000 0000 0102 0000 004E 0000 0000 [@D.....N....]
    00050: 0101 0000 0057 0000 0000 0103 0000 0049 [.....W.....I]
    00060: 0000 0000 0104 006F 7466 0049 0000 0000 [.....otf.I....]
    00070: 0108 0070 6172 6D73 7663 0049 0000 0000 [...parmsvc.I....]
    00080: 0104 0073 696D 0049 0000 0000 0101 0000 [...sim.I.....]
    00090: 6700 0000 0001 0200 0000 4900 0000 0001 [g.....I.....]
    000A0: 1200 4953 502D 496E 436F 6E74 726F 6C20 [...ISP-InControl ]
    000B0: 5349 4D00 4700 0000 0001 0600 0000 4100 [SIM.G.....A.]
    000C0: 0000 0001 0349 0000 0000 0112 0070 6172 [.....I.....par]
    000D0: 6D5F 7075 626C 6973 6865 7228 3429 0049 [m_publisher(4).I]
    000E0: 0000 0000 0102 0031 0049 0000 0000 0102 [.....1.I.....]
    000F0: 0031 0049 0000 0000 0102 0038 0041 0000 [.1.I.....8.A..]
    00100: 0000 0101 4200 0000 0001 006D 0000 0000 [....B.....m....]
    00110: 0101 0000 0063 4D53 5500 0154 0000 0000 [.....cMSU..T....]
    00120: 0171 3DDD 1A8F 7794 4055 0000 0000 0106 [.q=...w.@U.....]
    00130: 006C 616E 6365 004D 0000 0000 0102 0000 [.lance.M.....]
    00140: 0069 0000 0000 0101 0000 0049 0000 0000 [.i.....I.....]
    00150: 0108 0053 494E 3030 3030 0043 5053 0000 [...SIN0000.CPS..]
    00160: 7463 4D53 4B00 5000 0000 0000 0000 0000 [tcMSK.P.....]
    00170: 0000 0000 0000 0000 0000 0054 0000 0000 [.....T.....]
    00180: 0172 1CDD 1A8F 7794 4043 504D 0000 0101 [.r....w.@CPM....]
    00190: 0000 0043 5056 0000 0102 0000 0000 0000 [...CPV.....]
    001A0: 0000 5A00 0000 0001 BD87 07C3 5B89 4340 [...Z.....[.C@]
    001B0: 5A00 0000 0001 BD87 07C3 5B89 4340 [Z.....[.C@]
```

## 2. Parameter Service Broker Log File

```
SM&C Log (isnull.smlog)
00100: 0000 0101 4200 0000 0001 006D 0000 0000 [....B.....m....]
00110: 0101 0000 0063 4D53 5500 0154 0000 0000 [.....cMSU..T....]
00120: 01E0 9B86 B287 7794 4055 0000 0000 0106 [.....w.@U.....]
00130: 006C 616E 6365 004D 0000 0000 0102 0000 [.lance.M.....]
00140: 0069 0000 0000 0101 0000 0049 0000 0000 [.i.....I.....]
00150: 0108 0052 414E 4430 3030 0043 5053 0000 [...RAND000.CPS..]
00160: 7463 4D53 4B00 5000 0000 0000 0000 0000 [tcMSK.P.....]
00170: 0000 0000 0000 0000 0000 0054 0000 0000 [.....T.....]
00180: 01E1 7A86 B287 7794 4043 504D 0000 0101 [...z...w.@CPM....]
00190: 0000 0043 5056 0000 0102 0000 0000 0000 [...CPV.....]
001A0: 0000 5A00 0000 0001 67B2 1C9D 3359 4E40 [...Z.....g...3YN@]
001B0: 5A00 0000 0001 67B2 1C9D 3359 4E40 [Z.....g...3YN@]
>>>Decoded PUBLISH Message Header:
{msgHeader = {dataType = x; endianism = 0}, URIfrom = "lance", authenticationId
= {(9 bytes @ addr 56c4a0):
00000: 616E 6F6E 796D 6F75 73 [anonymous]
}, URItO = "THERE", timestamp = 054/13:52:57.061, QoSlevel = 2, priority = 1, do
main = {"otf", "parmsvc", "sim"}, networkZone = "", session = 2, sessionName = "
ISP-InControl SIM", interactionType = 6, interactionStage = 3, transactionId = "
parm_publisher(4)", area = "1", service = "1", operation = "8", version = 1, isE
rror = 0}
>>>Decoded PUBLISH Message Body: updateList =
timestamp = 054/13:52:57.061; sourceURI = lance; updateType = 2;
idList = {"RAND000"}
entityId = (null); definitionId = (null); occurrenceId = (null); statusId = (nul
l); timestamp = 054/13:52:57.061;
generationMode = 1; validityState = 2; rawValue = 60.696888; convertedValue = 60
.696888
>>>Encoded PUBLISH (UpdateList) Message:
(446 bytes @ addr 5b8b90):
00000: 7800 0000 0001 5500 0000 0001 0600 6C61 [x.....U.....la]
00010: 6E63 6500 4C00 0000 0001 0900 616E 6F6E [nce.L.....anon]
00020: 796D 6F75 7355 0000 0000 0106 0054 4845 [ymousU.....THE]
00030: 5245 0054 0000 0000 0131 75B8 B287 7794 [RE.T.....1u...w.]
00040: 404F 0000 0000 0102 0000 004E 0000 0000 [@D.....N.....]
00050: 0101 0000 0057 0000 0000 0103 0000 0049 [.....W.....I]
00060: 0000 0000 0104 006F 7466 0049 0000 0000 [.....otf.I.....]
00070: 0108 0070 6172 6D73 7663 0049 0000 0000 [...parmsvc.I.....]
00080: 0104 0073 696D 0049 0000 0000 0101 0000 [...sim.I.....]
00090: 6700 0000 0001 0200 0000 4900 0000 0001 [g.....I.....]
000A0: 1200 4953 502D 496E 436F 6E74 726F 6C20 [...ISP-InControl ]
000B0: 5349 4D00 4700 0000 0001 0600 0000 4100 [SIM.G.....A.]
000C0: 0000 0001 0349 0000 0000 0112 0070 6172 [.....I.....par]
000D0: 6D5F 7075 626C 6973 6865 7228 3429 0049 [m_publisher(4).I]
000E0: 0000 0000 0102 0031 0049 0000 0000 0102 [.....1.I.....]
000F0: 0031 0049 0000 0000 0102 0038 0041 0000 [.1.I.....8.A..]
00100: 0000 0101 4200 0000 0001 006D 0000 0000 [....B.....m....]
00110: 0101 0000 0063 4D53 5500 0154 0000 0000 [.....cMSU..T....]
00120: 019D 36B8 B287 7794 4055 0000 0000 0106 [...6...w.@U.....]
00130: 006C 616E 6365 004D 0000 0000 0102 0000 [.lance.M.....]
00140: 0069 0000 0000 0101 0000 0049 0000 0000 [.i.....I.....]
00150: 0108 0053 494E 3030 3030 0043 5053 0000 [...SIN0000.CPS..]
00160: 7463 4D53 4B00 5000 0000 0000 0000 0000 [tcMSK.P.....]
00170: 0000 0000 0000 0000 0000 0054 0000 0000 [.....T.....]
00180: 0111 11B8 B287 7794 4043 504D 0000 0101 [...w.@CPM....]
00190: 0000 0043 5056 0000 0102 0000 0000 0000 [...CPV.....]
001A0: 0000 5A00 0000 0001 43F2 78B2 645D 3140 [...Z.....C.x.d]1@]
001B0: 5A00 0000 0001 43F2 78B2 645D 3140 [Z.....C.x.d]1@]
>>>Decoded PUBLISH Message Header:
{msgHeader = {dataType = x; endianism = 0}, URIfrom = "lance", authenticationId
= {(9 bytes @ addr 56c4a0):
00000: 616E 6F6E 796D 6F75 73 [anonymous]
}, URItO = "THERE", timestamp = 054/13:52:57.064, QoSlevel = 2, priority = 1, do
main = {"otf", "parmsvc", "sim"}, networkZone = "", session = 2, sessionName = "
ISP-InControl SIM", interactionType = 6, interactionStage = 3, transactionId = "
parm_publisher(4)", area = "1", service = "1", operation = "8", version = 1, isE
rror = 0}
>>>Decoded PUBLISH Message Body: updateList =
timestamp = 054/13:52:57.064; sourceURI = lance; updateType = 2;
idList = {"SIN0000"}
entityId = (null); definitionId = (null); occurrenceId = (null); statusId = (nul
l); timestamp = 054/13:52:57.064;
generationMode = 1; validityState = 2; rawValue = 17.364818; convertedValue = 17
.364818
parm_publisher(4) , area = 1, service = 1, operation = 8, version = 1, isE
rror = 0}
>>>Decoded PUBLISH Message timestamp = 054/13:52:57.064
idList = {"SIN0000"}
```

### 3. Parameter Service Subscriber Log File

```

SM&C Log (parm_subscriber.smlog)
000A0: 1200 4953 502D 496E 436F 6E74 726F 6C20 [..ISP-InControl ]
000B0: 5349 4D00 4700 0000 0001 0600 0000 4100 [SIM.G.....A.]
000C0: 0000 0001 0449 0000 0000 010B 0069 7370 [.....I.....isp]
000D0: 6E75 6C6C 2836 2900 4900 0000 0001 0200 [null(6).I.....]
000E0: 3100 4900 0000 0001 0200 3100 4900 0000 [1.I.....1.I...]
000F0: 0001 0200 3800 4100 0000 0001 0142 0000 [....8.A.....B..]
00100: 0000 0100 7700 0000 0001 0100 0000 7200 [....w.....r.]
00110: 0000 0000 4900 0000 0001 0200 3700 6D00 [....I.....7.m.]
00120: 0000 0001 0100 0000 634D 5355 0001 5400 [.....cMSU..T.]
00130: 0000 0001 7DD2 C912 9977 9440 5500 0000 [....}....w.@U...]
00140: 0001 0600 6C61 6E63 6500 4D00 0000 0001 [....lance.M.....]
00150: 0200 0000 6900 0000 0001 0100 0000 4900 [....i.....I.]
00160: 0000 0001 0800 5349 4E30 3030 3000 4350 [.....SIN0000.CP]
00170: 5300 0074 634D 534B 0050 0000 0000 0000 [S..tcMSK.P.....]
00180: 0000 0000 0000 0000 0000 0000 0000 5400 [.....T.]
00190: 0000 0001 9A99 C912 9977 9440 4350 4D00 [.....w.@CPM.]
001A0: 0001 0100 0000 4350 5600 0001 0200 0000 [.....CPV.....]
001B0: 0000 0000 005A 0000 0000 01AA BAB0 AE77 [.....Z.....w]
001C0: 3C50 405A 0000 0000 01AA BAB0 AE77 3C50 [<P@Z.....w<P]
001D0: 40                                     [@]
>>>Decoded NOTIFY Message Header:
{msgHeader = {dataType = x; endianism = 0}, URIfrom = "lance", authenticationId
= {(9 bytes @ addr 566b10):
  00000: 616E 6F6E 796D 6F75 73                                     [anonymous]
}, URIto = "THERE", timestamp = 054/13:53:58.149, QoSlevel = 2, priority = 1, do
main = {"otf", "parmsvc", "sim"}, networkZone = "", session = 2, sessionName = "
ISP-InControl SIM", interactionType = 6, interactionStage = 4, transactionId = "
isnull(6)", area = "1", service = "1", operation = "8", version = 1, isError =
0}
>>>Decoded NOTIFY Message Body: subscriptionUpdateList =
subscriptionId = 7
timestamp = 054/13:53:58.149; sourceURI = lance; updateType = 2;
idList = {"SIN0000"}
entityId = (null); definitionId = (null); occurrenceId = (null); statusId = (nul
l); timestamp = 054/13:53:58.149;
generationMode = 1; validityState = 2; rawValue = 64.944805; convertedValue = 64
.944805
}
>>>Decoded NOTIFY Message | subscriptionId = 7
timestamp = 054/13:53:58.149Body: subscriptionUpdateLi

```

#### 4. Parameter Service Test Display

